RESUSCITATION

CHARLES · A · LAUFFER · M · D ·

MED. DEPT., U. S. A.

BY THE SAME AUTHOR

PUBLISHED BY

JOHN WILEY & SONS

Electrical Injuries.

Their Causation, Prevention and Treatment. Designed for the Use of Practical Men. 16mo, vi+77 pages. Cloth, $0.50 net.

RESUSCITATION

FROM

ELECTRIC SHOCK, TRAUMATIC SHOCK, DROWNING, ASPHYXIATION FROM ANY CAUSE

BY MEANS OF ARTIFICIAL RESPIRATION BY THE PRONE PRESSURE (SCHAEFER) METHOD,

WITH ANATOMICAL DETAILS OF THE METHOD, AND COMPLETE DIRECTIONS FOR SELF-INSTRUCTION

C BY

CHARLES A. LAUFFER, A.M., M.D.

Medical Director, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

FIRST EDITION

FOURTH THOUSAND

NEW YORK

JOHN WILEY & SONS, Inc.

London: CHAPMAN & HALL, Limited

1914

THE SCIENTIFIC PRESS
ROBERT DRUMMOND AND COMPANY
BROOKLYN, N. Y.

PREFACE

The universal adoption of Prone Pressure as the standard method of resuscitation seems assured. Its simplicity and efficiency commend its general adoption; its successful achievements are numerous. A conflict of methods may cause dangerous delay, and in any given case is a misfortune. The one-man method, the method that requires no equipment other than the hands of a man's friend, is based on sound anatomical principles.

The paper herewith presented was read before the Philadelphia Electric Company Section of the National Electric Light Association, at an enthusiastic meeting that crowded Franklin Institute, November 18, 1912.

The material is presented in a form suitable for those who have neglected the study of the mechanism of the human engine, as well as for those whose knowledge of human anatomy needs refreshing

While the method can be fully described in one hundred words, there are many details that deserve more adequate description, if the memory is to be impressed and blunders obviated.

The instances of success in resuscitation are related so as to inspire others to like humane achievement, and the purpose of the author will be attained, if the booklet contributes to that end.

CHARLES A. LAUFFER, M.D.

WILKINSBURG (PITTSBURGH), PA
Dec. 2, 1912.

CONTENTS

PAGE

Instruction in Resuscitation 1

Forethought 4

Successful Results 5

Types of Cases Requiring Resuscitation 8

Mechanism of Respiration 11

The Method 23

I. Position of Patient 23

II. Posture of Operator 25

III. Mode of Operation 27

IV. Rate per Minute and Duration of Operation . 31

Supplemental Assistance 35

Mechanical Resuscitation 39

Prof. Schaefer on the Prone Pressure Method. 45

RESUSCITATION

INSTRUCTION IN RESUSCITATION

I accepted with genuine pleasure the invitation of your chairman to speak on the subject of artificial respiration, along the same lines as the paper I prepared for The Pennsylvania Electric Association, at Bedford Springs, in September of this year. During the past three years I have neglected no opportunity for advancing the cause of artificial respiration by the Prone Pressure (or Schaefer) method, both by writing and speaking, as well as by demonstration. I have written up the Prone Pressure method for five magazines, and also included the subject in a booklet on "ELECTRICAL INJURIES," and have trained fully 2000 men in the art and instructed them in the theory of the Prone Pressure method.

It is a fortunate trend of public opinion that makes it incumbent on every intelli-

gent citizen to know how to give artificial respiration. It is no longer exclusively the role of a physician to give artificial respiration, for if men in dangerous trades do not think enough of one another to practice the method, in anticipation of any possible emergency, why should physicians bother about it? Why should a doctor risk breaking his neck in a mad race to reach the scene of disaster too late to be of any service? Artificial respiration must be begun instantly by the victim's comrades, and the supplemental assistance is peculiarly the province of the physician.

While there are more physicians per 100,000 of population in the United States than in any other country, a physician, like the policeman, is invariably out of reach when an emergency arises. Laymen simply must learn how to bring back life in an apparently dead body, else the number of fatalities from these tragic accidents, fatal because of the ignorance of bystanders, will continue to appall.

Some stand-patter may insist that we are hearing too much about resuscitation these days; that a generation ago the general public was not expected to know anything about artificial respiration. We should realize that we are living in the midst of more dangers

than a generation ago; the score of gases encountered in the industries and in our homes, the wide application of electricity, combined with other causes, have added to the perils of modern life; never before was the diffusion of the knowledge of resuscitation so necessary as in the present age.

FORETHOUGHT

Complete details of how to rescue a comrade from a dangerous situation must be thought out in advance; the location of switches, and modes of short-circuiting lines, and of separating a body from an electrical contact without danger to the rescuer, must be studied out in advance by the individuals of each department of electrical service. The same may be said for workers in mines, for gas men, and for every line of industry. With adequate circumspection and forethought, fatalities can be much reduced. And when these apparent calamities do occur, consternation seizes especially those not adequately trained to cope with the responsibilities of the situation. Artificial respiration should be practiced by everybody, in anticipation of any such emergency.

SUCCESSFUL RESULTS

Among the men whom I have instructed in this method, six to our knowledge have had occasion to use it; three in the factory, namely, a case of concussion of the brain with unconsciousness and failure of both heart and respiration, requiring an hour's time; and two severe cases of electric shock, with complete success in each one of these three cases. And three cases reported outside of the factory, namely, one case of suffocation by smoke—life seemed extinct, when the firemen rescued the victim from the burning building, but a Westinghouse man in the crowd knew the Prone Pressure method, and revived him before the ambulance and police surgeon arrived; a second case was that of a man hit on the head with a baseball; respiration was so completely arrested that it seemed he would have died, but for the prompt assistance by artificial respiration on the part of one of our men; a third case was one of drowning—an employee who had profited by the instruction taught the method to his

son, and the son's knowledge was the means of saving the life of a comrade from drowning. All three cases outside of the works were completely successful. In these six cases, from divergent conditions, requiring artificial respiration, the percentage of recovery is 100. Saving six lives in two years is worth while, and these 2000 trained men in the rest of their lives may have much more opportunity for this service to their fellows.

The sacrifice of life in our country resulting from ignorance of methods of resuscitation challenges efforts at conservation. It is equally necessary to know how to give artificial respiration whether in industry or in sportsmanship. A man suffering from electric shock will perish unless revived by some manual or mechanical method of artificial respiration; and so may the man who has been pinned under his automobile, or hit over his solar plexus in a boxing bout.

I know a man who has resuscitated six victims of electric shock, all of them fatal cases but for his prompt and efficient efforts at artificial respiration. Voltages commonly exceed 130,000 in his department, yet his percentage of recoveries is 100. This man is an enthusiastic advocate of the Prone Pressure method.

Methods of resuscitation succeed in elec-

tric shock because the victim commonly receives a mere leakage current from the line; the contact is brief and imperfect, and the dry, calloused skin, as of the palm, offers an exceedingly high electrical resistance. The frequent successes attending efforts at resuscitation have brought the subject of artificial respiration into national prominence.

TYPES OF CASES REQUIRING RESUSCITATION

(I) Electrical men in their zeal for artificial respiration forget that gas men need to know the method too, as Electric Shock is not the sole condition requiring methods of resuscitation. On the contrary the fact deserves emphasis, that a working knowledge of a good method of artificial respiration is essential in every walk of life. No man can predict whether or not his failure to learn how to give artificial respiration may any day be responsible for loss of life.

(II) Asphyxiation arises when the body is deprived of air; it is due to the presence of gases that will not support life—a man must have a constant supply of oxygen: (1) Illuminating gas, (2) the gases of mines, (3) carbon-monoxide from the defective oxidation in a stove, (4) the ammonia fumes of an ice plant, (5) gasoline fumes of a garage, (6) the gases of a blast furnace, (7) of molten brass, (8) of the manufacture of gas, (9) certain elements freed from their compounds, as bromine and chlorine, (10) certain dis-

infecting agents such as sulphur dioxide and formaldehyde, (11) the carbon dioxide waste from whatever source, (12) other non-respirable gases and fumes in various chemical processes, (13) exclusion of air, as in a bank vault, (14) confined air, as in the compartments of ships, (15) sewer gas, (16) suffocation by smoke; all these are among the causes that produce asphyxiation, and require artificial respiration.

Whenever from such a cause the face becomes pale or livid, unconsciousness intervenes, and breathing becomes irregular, or ceases, we know it is a case for artificial respiration.

(III) Inhalations of chloroform and ether may similarly cause a suspension of breathing, requiring instant withdrawal of the anæsthetic and immediate assistance in the way of artificial respiration.

(IV) Overdoses of laudanum, likewise, may cause failure of respiration, and among various measures of restoration, artificial respiration is often life-saving.

(V) Apparent death from Drowning is treated in precisely the same manner as electric shock, and, by the Prone Pressure (or Schaefer) method, one man alone can resuscitate a drowning comrade. Every time pressure is made upon the floating ribs of

the patient, water and mucus are expelled from his lungs and air passages, hence by this method the prospects of restoring the victim are most favorable.

(VI) In the shock produced by a heavy blow under the belt (a solar plexus blow), or on the jaw or neck, or as the result of a blow upon the head, "the wind is often knocked out of a man." The condition of Traumatic Shock produced by such an injury may prove fatal unless the victim is assisted. He must be made to breathe until his disturbed nerve centers recover their normal functions.

It should be remembered that while we can live forty days without food, and two days without water, life is in jeopardy when we are deprived of air for two minutes. On analysis, each of the six types of cases requiring resuscitation will be seen to be identical: the oxygen supply is cut off—in some cases by the substitution of noxious gases, in some by violent injuries, in others by a failure to eliminate the carbon dioxide produced in our tissues, which gas, when retained, paralyzes the respiratory center in the medulla (the physiological coördinating center of the brain), and inhibits the action of the diaphragm. They are all alike, in that the diaphragm is paralyzed (inhibited).

MECHANISM OF RESPIRATION

Without entering on the nervous mechanism of the respiration, and without considering the accessory respiratory muscles, it is in order to consider the gross anatomy involved in breathing.

The action of the diaphragm is well illustrated by the familiar bell jar experiment. (See illustration.) The lungs of a cat are carefully removed; this is readily accomplished by piercing the diaphragm, so as to allow the lungs to collapse. Each pleural cavity is nearly a perfect vacuum, so that the condition in nature is better than the experiment in the jar. The lungs so removed are tied to a piece of glass tubing, and the tubing is carried up through the rubber stopper of the bell jar. Over the bottom of the bell jar a sheet of rubber is stretched and fastened so as to be air-tight.

When this rubber is drawn down, the air pressure within the jar is reduced, and the atmospheric air moves in through the glass tubing and trachea, to fully distend the

lungs; as soon as the hand is withdrawn, and the flexible rubber falls back, the lungs completely collapse.

Bell Jar

This illustrates admirably how the pressure of atmospheric air fills the lungs when the diaphragm descends, and how the lungs are emptied when the diaphragm rises. It

will be seen that the lungs are perfectly passive.

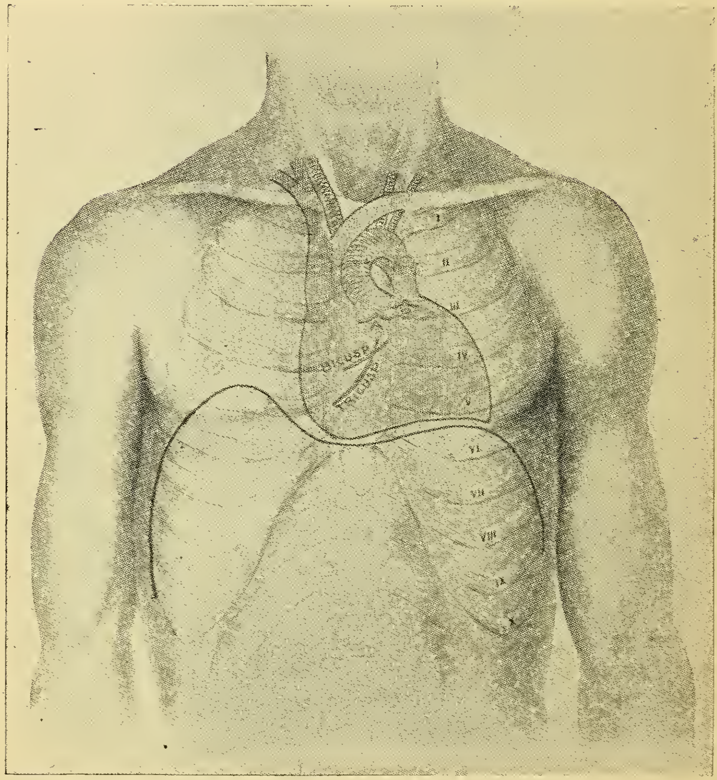
We have been granted permission to insert five illustrations from Dr. G. G. Davis's "Applied Anatomy," published by Lippincott, Philadelphia. Without some definite knowledge of the anatomy and mechanics of normal breathing, we cannot well understand the mechanics of artificial respiration. It is unfortunate how little attention many men—well versed in dynamos, motors, turbines—have given to the human engine.

Fig. No. 1. The line of the diaphragm is projected on the chest, and the heart and chief blood vessels are exhibited in relation to the ribs and cavity of the chest. It is well to remember that the diaphragm is a muscle; it is a voluntary muscle like the muscles of our arms, in that we can somewhat control our breathing; but in the main it is an involuntary muscle, like the muscle of the heart. The diaphragm is just as necessary to our breathing as the heart is to our circulation; the cessation of the action of either causes death.

In normal breathing the diaphragm descends, thus producing a partial vacuum in the lungs, and the air rushes in through our nostrils and mouth to inflate and dis-

tend our lungs. This filling of the lungs is called inspiration.

When the lungs are filled, the diaphragm



Davis's Applied Anatomy, Copyright 1910, J. B. Lippincott Co.

Fig. 1.

again rises; this compresses the lungs and the air is forced out. This emptying of the lungs is called expiration.

The chief respiratory muscle is thus seen to be the diaphragm; it rises and falls from the minute of our birth to the hour of our death, like the piston of an engine in its cylinder.

It will be observed that the diaphragm is a muscular partition and that it separates the chest, which contains the heart and lungs, from the abdomen, which contains the stomach, spleen, liver, kidneys, intestines, and other organs. The diaphragm is arched, with its convexity above and its concavity below; this concavity is filled with the stomach, spleen, liver and kidneys. It is also to be observed that ten of the twelve pairs of ribs are connected with the sternum (or breast bone); seven pairs by means of bone, and three pairs by means of costal cartilages. On the left side the diaphragm rises to the height of the sixth rib, and the stomach is separated from the heart only by the thickness of the diaphragm; on the right side the diaphragm rises to the height of the fifth rib, and separates the lungs from the liver.

The lowest ribs, the eleventh and twelfth, are also projected in this picture; they are seen to arise from the eleventh and twelfth thoracic vertebræ. They lie embedded in the muscles, and are in no wise attached to the sternum.

Fig. No. 2. The ribs, it will be observed, give protection to the organs most easily injured. Very little of the stomach is exposed to blows over the abdomen. The stomach is protected by the lower ribs on the left side; the liver by the ribs on the right side. This illustration with the interior abdominal wall removed shows the relation of the large and small intestines. The stomach is a muscular organ with a normal capacity of three pints.

Fig. No. 3. This illustration shows the bed of the stomach; the stomach has been removed. The spleen, the suprarenal and the left kidney are exposed, lying behind the stomach. The liver, it will be observed, is an organ of huge size and tremendous importance.

Fig. No. 4. This is an anterior-posterior section of a frozen body. It shows the diaphragm at the level of the fourth rib. Lung and heart are sectioned, above the diaphragm; and below the diaphragm are seen the stomach, transverse colon, spleen, pancreas, kidney and small intestines. This is a picture worth memorizing, as it bears directly on the problem of elevating the diaphragm in the act of giving artificial respiration. It is readily perceived that anything that will increase the pressure within the abdomen (intra-

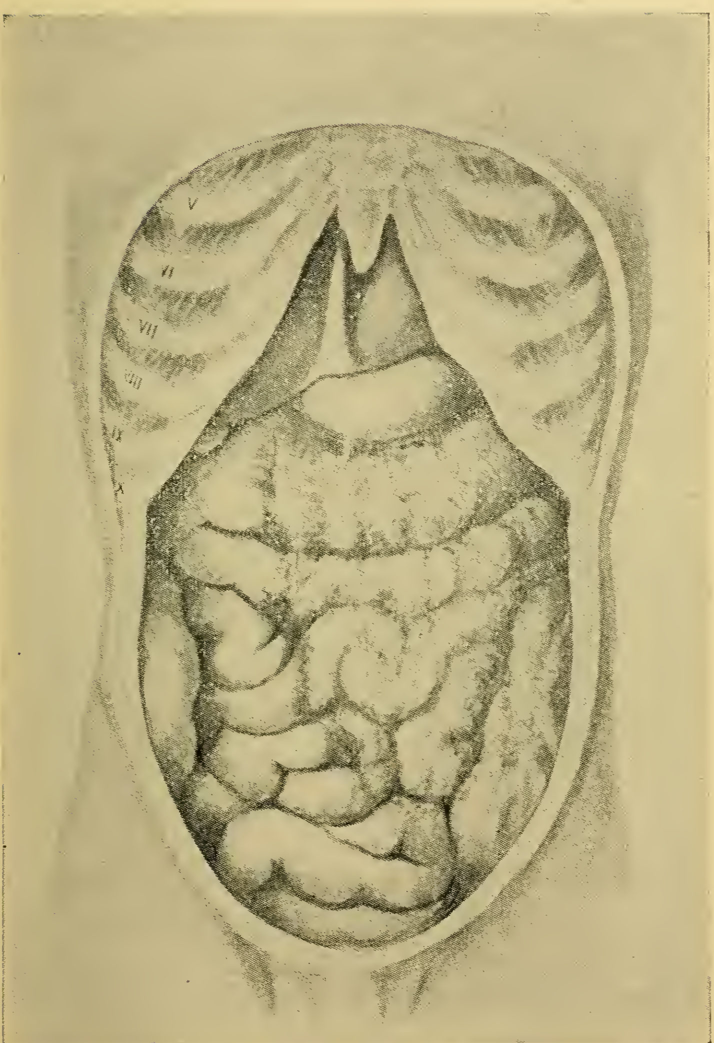
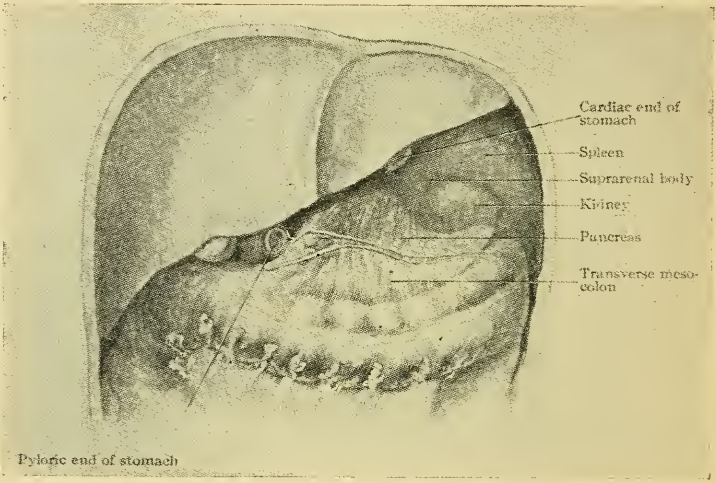


Fig. 2.

abdominal pressure) will elevate the diaphragm.

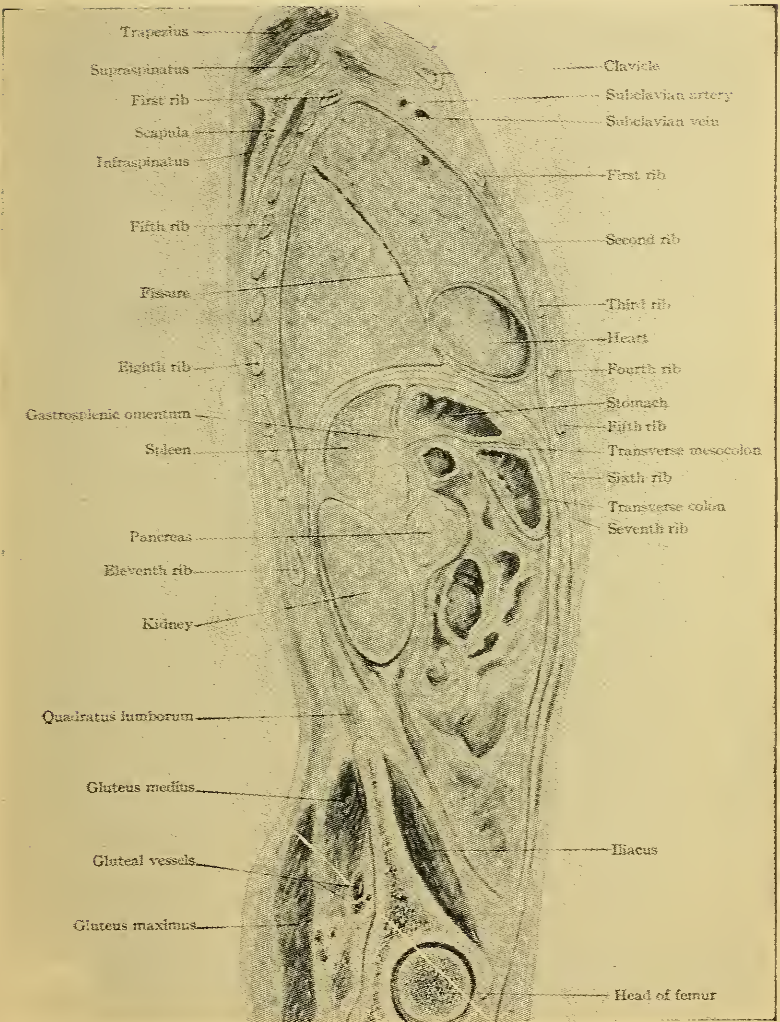
Fig. No. 5. This shows the spleen under the tenth rib; the kidneys under the eleventh and twelfth. As before stated *ten of the twelve* pairs of the ribs that arise from the vertebræ



Davis's Applied Anatomy, Copyright 1910, J. B. Lippincott Co.

FIG. 3.

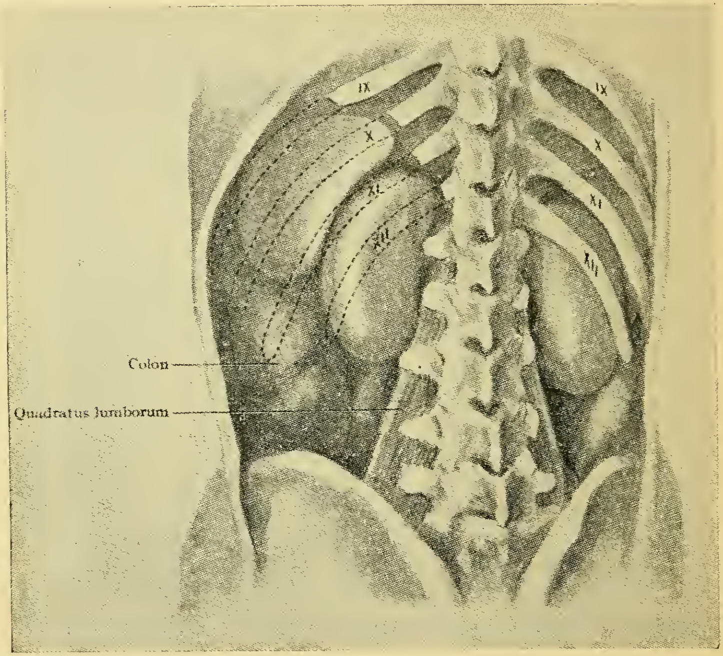
are attached to the sternum, completing a firm but elastic bony cage, known as the chest, or thorax. Two pairs are unattached in front, but end in the muscles; these are known as the floating ribs. These lower ribs (the eleventh and twelfth) are utilized in giving artificial respiration by the Prone Pressure method. To find these ribs and



Davis's Applied Anatomy, Copyright 1910, J. B. Lippincott Co.

FIG. 4.

make pressure on their free ends is the prime consideration. Prone Pressure is the worst imaginable method of artificial respiration, if pressure is made too high or too low, and



Davis's Applied Anatomy, Copyright 1910, J. B. Lippincott Co.

FIG. 5.

not made on the free ends of these floating ribs.

We press on the ends of the floating ribs like on a pump handle; the nearer their ends we make pressure the more leverage we have.

When they are pressed upon vertically and the pressure suddenly removed, their elasticity causes them to rebound to their natural position.

By compressing these floating ribs, thus shoving the abdomen against the ground, we shove forward the kidneys, and raise the pressure in the abdomen; this increased intra-abdominal pressure shoves the stomach, spleen and liver upward against the diaphragm. As the diaphragm is elevated it compresses and empties the lungs. Now relax the pressure of the hands—it is better to remove the hands entirely—and the resiliency of the parts causes the ribs to spring back into position, and enables the organs that have been displaced by the pressure to fall back into their normal relations. As these displaced organs flop back into their normal positions, the diaphragm descends, and there is a partial vacuum in the lungs; the air rushes in as in normal breathing, until the pressure within the lungs about equals atmospheric pressure.

In other words, the efficiency of the method is seen to depend on the elasticity of the thorax and abdomen and the tendency of the lungs to assume their normal shape and volume after being altered by any compressing force.

In every essential respect this artificial mode of respiration resembles natural breathing, except that a man gets more ventilation of his lungs than in ordinary breathing.

THE METHOD

There are four facts in the Prone Pressure (or Schaefer) method that require emphasis:

(*I*) *The position of the patient*

The man is laid on his stomach, face turned to one side, so that the mouth and nose do not touch the ground. The subject's arms are extended from his body above his head. (See illustration.)

This position causes the tongue to fall forward of its own weight, and so prevents its falling back into the air passages. This fact makes it possible for one man, alone and unassisted, to save the life of a comrade in electric shock, or other condition requiring artificial respiration.

Turning the head to one side prevents the face coming in contact with water or mud during the operation. There is no time for removal of the body to another place—the resuscitation must be begun the instant the body is recovered from the circuit, or other

RESUSCITATION.

source of trouble, even though other places in the neighborhood may be cleaner.

This position of the subject facilitates the removal of any foreign body from the mouth —tobacco, chewing gum, false teeth; and favors the removal of mucus, blood, vomitus, serum—any liquid that may be in the mouth or obstructing the air passages.

(*II*) *Posture of the operator*

The operator kneels, straddling one or both of the patient's thighs, or kneels by either side of the thighs, facing the patient's head.

The operator feels with both hands for the bony landmarks of the patient—the prominent bones of the pelvis, the muscles of the small of the back, and the floating ribs. With the lowest ribs located, the operator places his spread hands, with the thumb nearly parallel to fingers, so that the little finger curls over the end of the twelfth rib. With the hands on the pelvic bones we defeat the object of our work; hence, the bones of the pelvis are first located in order to avoid them. The lower margin of the hand must be free from the pelvis, and resting on the lowest rib.

We can more easily locate the ribs and avoid the pelvis by operating on the bare back of the victim. Hence, the shirt and other cloth-

ing should be torn off, and the operator's hands should be on the bare back of the patient.

The nearer the ends of the ribs the heels of the hands can be placed without sliding off, the better. The hands are thus far removed from the spine, and the fingers are nearly out of sight. If the thumbs are rotated outward somewhat, and held parallel to the fingers, it assists in holding the arms straight.

The fingers help some, but the chief pressure is exerted by the heels (thenar and hypothenar eminences) of the hands, with the weight coming straight from the shoulders. It is a waste of energy to bend the arms at the elbow and shove in from the sides, though a very muscular operator may succeed by this plan. Shoving the hands in at the sides in addition to the vertical pressure is less beneficial than the vertical pressure alone, besides being more fatiguing to the operator, because our backs are stronger than our arm muscles.

With the heels of the hands on the ends of the floating ribs, as described, the maximum leverage is exerted, and there is a corresponding reduction in the muscular exertion required on the part of the operator.

(*III*) *The mode of operation*

The operator's arms are held straight, and his weight is brought from his shoulders by bringing his body and shoulders forward. This weight is gradually increased until at the end of the three seconds of vertical pressure upon the lower ribs of the patient, the force is felt to be heavy enough to compress the parts; then the weight is suddenly removed; if there is danger of not returning the hands to the right position again, merely the pressure may be entirely remitted, but it is usually better to remove the hands entirely.

If the operator is a mere boy, and the victim an overweight adult, the boy can utilize over 80 per cent of his weight by raising his knees from the ground, and supporting himself entirely on his toes and the heels of his hands—the latter properly placed on the ends of the floating ribs of the patient. In this manner a mere boy, if he knows how to locate his hands, can work as effectively as a grown man.

A light feather, or a piece of absorbent cotton drawn out thin and held near the nose by someone, will indicate by its movements whether or not there is a current of air going and coming, with each forced expiration and

spontaneous inspiration. With such assurance as this, the operator possesses increased hopes of ultimate success. Should the elasticity of the ribs and the resiliency of the other organs fail, and there be no signs of returning animation, what then? With no discernible air coming and going, there may still be hope, keep busy. But, if a pulmotor has by this time arrived, if it is in good working condition, it can be given a trial.

As to the dangers incident to this mode of operation, questions are being continually addressed to the author. Some very strong and very heavy men doubtless do exert more pressure on the floating ribs than is necessary for the proper administration of artificial respiration. If the operator is at all observant, he can feel the ribs give way, and remit pressure; and he can see them spring up into place, whereupon he can again apply the pressure.

The author has never seen a case of fracture of the ribs, or any damage to internal organs arise from the Prone Pressure method. On the contrary, it is the method par excellence for restoring the victims of foot ball, basket ball, running (any form of knockout or excessive fatigue), as well as the foregoing enumerated causes of paralysis (inhibition) of the diaphragm. With the patient flat on

his stomach, the saliva will run from his mouth and his tongue will fall forward, and the rubbing, slapping and other methods of bringing him to will more quickly succeed; even in those cases where the breathing has not been arrested, pressure on the floating ribs is helpful in restoring him to condition.

Passive movements applied to the floating ribs, without resistance on the part of the person who receives the treatment, improve the wind as many athletes know. This treatment loosens up the movable organs above and below the diaphragm, and by giving freedom of movement to the diaphragm, imparts tone and vigor to the whole system. Such exercise conveys a feeling of exhilaration, when the operator works rhythmically and when the subject passively submits to it. It should be made a part of every gymnastic course where it has not already been adopted, especially in college and Y. M. C. A. gymnasiums, and in boy scout organizations. We are informed that it is employed in the United States army as part of the setting-up exercises.

In brief, such passive pressure on the floating ribs improves the health, and can do no damage to a healthy man. There is an occasional individual who knows himself to be a living pathological museum; with extensive pleural adhesions, pericardial adhesions, can-

cer of the liver or stomach, advanced pulmonary tuberculosis, or the like—with such complications, what method of resuscitation could be recommended? Such persons, fortunately, are not in the active pursuits of life, so that the employment of the Prone Pressure method, where required, is not likely to affect them; nor do such persons voluntarily elect this mode of physical culture.

Let us remember that in a normal man the organs above the diaphragm and those beneath it are freely movable with each respiration. The range of movement of the heart between forced inspiration and forced expiration exceeds three inches. The author saw this demonstrated by X-ray photographs of the heart in 1906 in the Berlin Charité Hospital; it is well known to every radiographer. As this migration of the diaphragm and associated organs occurs with every breath we take, it is to be regarded as normal and healthful; and so is the proper administration of the Prone Pressure method of artificial respiration, in assisting nature, whether for purposes of resuscitation or purely for physical culture.

(IV) *Rate per minute and duration of operation*

The natural rate of breathing is twelve to fifteen times per minute. The rate of operation should not exceed this; the lungs must be thoroughly emptied by three seconds of pressure, then their refilling takes care of itself. Pressure and release of pressure—one complete respiration—occupies about five seconds. If the operator is alone he can be guided in each act by his own deep, regular respiration, or by counting, or by his watch lying by his side; if comrades are present he can be advised by them.

The duration of the efforts at artificial respiration should ordinarily exceed an hour; indefinitely longer if there are any evidences of returning animation, by way of breathing, speaking, or movements. There are liable to be evidences of life within twenty-five minutes in patients who will recover from electric shock, but where there is doubt the victim should have the benefit of the doubt. In drowning, especially, recoveries are on record after two hours or more of unconsciousness; hence, this method, being easy of operation, is more liable to be persisted in. The phy-

sician on his arrival can determine if there is any heart action; the pulse at the wrist may stop, and the heart still be beating—a condition calling for continuous rhythmic efforts at resuscitation, combined with medication.

In this connection it must be remembered that a physician is not necessarily infallible; two cases have been brought to my attention within the past year where physicians examined victims of electric shock, and reported them dead, yet both men were revived by artificial respiration. One was revived within an hour, the other in two and one-half hours. The friends of these men had better muscle, and more courage, than the physicians who pronounced the doleful verdict; and courage plus muscle won out. When a man's comrades know the possibilities of the Prone Pressure method, and have confidence in their ability to apply it, you may rely upon it that the victim of accidental electrocution will not perish unassisted before the eyes of his friends.

Just a word in relation to the fibrillating heart. The electric current arrests the action of the heart before it stops the respiration, by paralyzing the diaphragm, according to the best observers in physiological laboratories. Suppose the heart is contracting irregularly

in groups of muscle fibres, and is not propelling its two ounces of blood with each ventricular contraction. That is what you must often combat—both heart failure and respiratory failure.

By the Prone Pressure method, the stomach, spleen and liver are hurled up against the heart once every five seconds—only the thickness of the diaphragm separates the heart from the organs that are thrown against it; artificial respiration by this method is effectual massage of the heart. And furthermore, the great abdominal vessels are much compressed, and blood is likewise forced from the liver into the heart; when the heart is filled in this manner, it tends to recover its normal contractions.

It is a crime to stop and theorize about "the fibrillating heart," when a man is down and out and is in need of intelligent efforts at resuscitation; then and all the time the fibrillating heart is a good thing to forget.

The man on the firing line must assist his comrade with unfaltering courage, for success is the rule in these cases, if the artificial respiration be begun at once and continued without any interruption. Please remember that electric shock, and gas, and drowning, and other conditions that paralyze the diaphragm, are

as a rule not so dangerous to life as the ignorance and incompetence of the man's comrades, in the way of rendering immediate assistance.

SUPPLEMENTAL ASSISTANCE

When there is but one person with the victim, the artificial respiration will occupy his whole time. It is the chief thing to be done. It alone will usually save life.

If a second person is present, his first thought should be the man's mouth—he must be sure it contains no tobacco, gum, false teeth, blood, mucus—it can be cleaned in a moment with a stroke of the finger. He can make sure that the tongue is forward, and that no tight collar unduly constricts the neck. If the muscles are spastic and the jaws tightly closed, this second man can assist the first, and both can exert their whole weight in overcoming the rigidity of the abdominal muscles. Even if the jaws are set and rigid, Prone Pressure will succeed, with the patient breathing through his nose.

The second man can then direct his attention to providing some form of ammonia for the patient to inhale.

An unconscious patient must not be given any liquids whatever by the mouth; the liquids under these conditions will reach the lungs rather than the stomach. But medicines may be administered by (a) inhalation and (b) by hypodermics.

Aromatic spirits of ammonia may be poured on a handkerchief and held continuously within three inches of the face and nose; if other ammonia preparations are used, they should be diluted or held further away. Try it on your own nose first. We should not take an unfair advantage of an unconscious patient, by using aqua ammonia in a manner dangerous to his mucous membranes. If no ammonia is available, then spirits of camphor or spirits of menthol may be similarly employed.

In cases of asphyxiation, the patient must be removed to a better atmosphere; a tank of oxygen is then a valuable accessory to artificial respiration, though in electric shock and other conditions requiring artificial respiration, ordinary atmosphere, and some preparation of ammonia, if available, is all that is required.

The doctor should be summoned at once. On his arrival he can support the action of the heart, and the respiration, by the hypodermic administration of such drugs as strych-

nine, atropin, digitalin, camphor in oil, adrenalin, etc., in appropriate dosage, as conditions require.

The most efficient service a crowd can render is to stand back, and allow the patient to have air, and not interfere with the person or persons endeavoring to resuscitate him.

It is to be distinctly understood that valuable as drugs are, the prime consideration is continuous, rhythmic, uninterrupted, artificial respiration. Other things are supplemental, more or less incidental, such as rubbing the hands, paddling the buttocks or feet, pulling on the tongue, stretching the sphincter muscle of the anus, sprinkling cold water on the face, or procuring blankets and hot-water bottles, if the patient is exposed to undue cold.

The patient may be apparently recovered and able to breathe, but lapses again into unconsciousness, and the breathing discontinues. In that event, we must resume the artificial respiration as often as is necessary to restore the patient. We dare not stop the Prone Pressure method, nor permit the patient to stand up, until his breathing has become regular.

There should be no delay in the attempt to revive the patient, such as is incident to

removing the victim in an ambulance; he must be revived first, or the artificial respiration must be carried on in the ambulance en route to the hospital.

MECHANICAL RESUSCITATION

Electrical excitation is a recognized method in restoring life in an apparently dead body. Experiments of this character have been carried on for years in every physiological laboratory in this country and in Europe. Dogs are usually chosen. The dogs are chloroformed until dead, or until respiration has ceased, and all heart action has discontinued. They are then revived by electrical excitation. Animals apparently dead four or five minutes are resuscitated, and when once restored to life the animal lives and shows no after effects. "Electrocuted dogs are resuscitated less readily than are chloroformed dogs."*

The electrical apparatus devised by this author, and by others, is a valuable contribution to science, but has not superseded the reliable manual methods. Why rely on the

* Dr. L. G. Rubinovitch, in The Journal of the American Medical Association, Vol. LXI, No. 8, article on "Electrical Resuscitation after Heart Failure under Chloroform or Electrocution."

arrival of certain equipment, when you know that a patient will pass into eternity unless instantly assisted?

In an address before the Berlin Congress of 1890, Dr. H. C. Wood of the University of Pennsylvania called attention to the value of FORCED ARTIFICIAL RESPIRATION.* He declared that he had repeatedly taken dogs in which both respiratory and heart movements had been absolutely arrested by chloroform or by ether, and had restored them to life by pumping air in and out of the lungs. All the apparatus that Dr. Wood believed necessary was a pair of bellows of proper size, a few feet of India-rubber tubing, a face mask, and two sizes of intubation-tubes† (in case the face mask should not suffice); also a valve arrangement, so that the operator can allow the escape of any excess of air thrown by the bellows.

He further called attention to the fact that Dr. Fell of Buffalo had demonstrated

* American Text-Book of Surgery, 1903.

† It is probable that the Pulmotor would be a more reliable device if its makers likewise recognized the defects of a mask; air may enter the stomach as well as the lungs, and intubation is then the remedy. Pressure over the trachea, as recommended in Pulmotor literature, may exclude air from the lungs as well as the stomach.

the extraordinary efficacy in man of forced artificial respiration, in severe morphine poisoning, so that the methods of the physiological laboratory must be considered applicable to human beings. Dr. Fell used a bellows apparatus, a receiving chamber for warming the air, and a valve for control of air pressure, opened and closed by a movement of the finger.

The precaution advanced is this: "Due care must be exercised that no force sufficient to rupture the air-vesicles is employed."

In natural breathing, as previously described and illustrated, the diaphragm rises and compresses the lungs, and the air is forced out of them; by the Prone Pressure method, the organs below are made to shove the diaphragm upward, and the lungs are thus compressed, the air being forced out. In both natural breathing and the Prone Pressure method the diaphragm descends of itself; in the former spontaneously, while in the latter the elasticity and resiliency of the ribs and displaced organs make the descent of the diaphragm certain, as soon as the compressing force is removed from the ends of the floating ribs. Then the lungs are a partial vacuum—there is negative pressure—and atmospheric air rushes in through the trachea to fill and inflate the lungs. The lungs are passive;

there is thus no possibility of damage to the air-vesicles, either in normal breathing or in artificial respiration by the Prone Pressure method.

But contrast this with any bellows type of apparatus; unless enough pressure is exerted to distend the lungs and shove down the diaphragm, it is not very efficient, so that at best this type of apparatus may be regarded as potentially dangerous, and accepted as a last resort only where tissue resiliency is much impaired.

It may be remarked that of the various mechanical devices of the bellows type available for giving artificial respiration, the Draeger Pulmotor is being most exploited, and is highly recommended by the Bureau of Mines in the Pittsburgh district.

We are informed that Pittsburgh, in endeavoring to apply its slogan, "Pittsburgh Promotes Progress," has placed a pulmotor on every patrol wagon. Other cities are doing likewise. Policemen and firemen of all cities should be thoroughly trained in resuscitation by the Prone Pressure method. Such instruction would certainly contribute more to the general welfare, in the conservation of life, than the installation of any type whatsoever of mechanical resuscitation device on every ambulance and patrol wagon.

The author has in his possession a letter, the writer of which talked with the superintendent in charge of the Water Side Stations No. 1 and No. 2, of the New York Edison Company. He has used this resuscitation device with great success, "having resuscitated five out of the last six persons on whom it was tried; the one person on whom the device failed had been dead so long, that he was turning black. One woman who had been apparently dead for three hours was revived after the machine had been in operation almost two and a half hours."

We believe that this is an extravagant claim; that no manual method, and no mechanical device, can be relied on to resurrect the dead. After so long an interval has elapsed, unless the work of resuscitation has been continuously performed, life is doubtless extinct. After all, there is nothing so dependable as the hands of a man's friends. Mechanical devices may be too remote, or when procured may be out of order, and not bring results.

In cases of asphyxiation by poisonous gases, the Pulmotor, since it employs oxygen, and exerts suction as well as pressure, is serviceable; it has a field where fractured ribs and ruptured viscera (as in falls from a pole), or extensive body burns, complicate the employ-

ment of the Prone Pressure method. But even with these complications, should there be no Pulmotor instantly available, it is better to employ the Prone Pressure method, and ignore the injuries for the time being; the infliction of pain, in this instance, may more quickly restore the respiration.

It is suggested, by the way, that the generation of ozone in the room will improve the prospects of recovery, and is perhaps superior to a tank of oxygen.

It is questionable if the various mechanical devices now on the market, or which may hereafter be invented, can ever "wholly supersede manual methods of resuscitation."

"Whatever in the way of equipment may some day merit general adoption, we know that no reliance can be placed on any outfit that cannot be carried with every electrical workman, and that is not instantly available. We know that success in artificial respiration is attained by the Prone Pressure method, and by other manual methods. Indeed, ignorance of such a method of resuscitating a comrade is criminal negligence on the part of any man of normal intelligence and conscience."*

* Extract from "Electrical Injuries," Chas. A. Lauffer, M.D., John Wiley & Sons, New York.

PROF. SCHAEFER ON THE PRONE PRESSURE METHOD

The most appropriate conclusion to this paper, I believe, would be to insert some extracts from a paper on the subject by Prof. E. A. Schaefer, read in Chicago, 1908, before the section on surgery of the National Convention of the American Medical Association.*

"In 1890 the Royal Medical and Chirurgical Society of London appointed a committee to investigate these and other methods of performing artificial respiration, and of this committee I was made chairman. A large number of experiments were performed on the cadaver, which were mostly futile by reason of the difficulties presented by post mortem rigidity. Subsequently transferring the work to Edinburgh, we made similar investigations

* Extracts from "Artificial Respiration in its Physiological Aspects," by E. A. Schaefer, F.R.S., Professor of Physiology in the University of Edinburgh, Edinburgh; Journal of the American Medical Association, Vol. LI, No. 10.

on the living passive subject, and also investigated in dogs the physiologic phenomena presented in drowning and the best means of producing recovery in these animals by artificial respiration. In this research I received the aid of Dr. P. T. Herring of the physiology department of the University of Edinburgh, and of my other assistants there.

"As the outcome of this work we concluded that, for the performance of artificial respiration without the aid of bellows or other apparatus, a pressure method is best, and that such a method is more efficient with the patient in the prone position and with the pressure applied vertically over the lowest ribs. In this way not only is the thorax compressed, but also the abdomen, against the ground. The pressure against the abdomen forces the viscera against the diaphragm, which is thereby itself moved upward, driving air out of the lungs. On relaxing the pressure the elasticity of the parts causes them to resume their former shape and volume, and the air is drawn in through the glottis. The pressure is exerted gradually and slowly, occupying some three seconds; it is then removed during two seconds and again applied; and so on some twelve times a minute. To this method I have given the name of 'the Prone Pressure method.'

"In performing it the operator kneels or squats by the side of or across the patient, places his hands over the lowest ribs and swings his body forward and backward so as to allow his weight to fall vertically on the wrists and to be removed; in this way hardly any muscular exertion is required. The efficiency of a pressure method of artificial respiration depends on the fact that after an ordinary expiration the thorax still contains some 1500 c.c. of air which can be expelled by a forced expiratory effort; this is the reserve or supplementary air of Hutchinson. It is easy to conceive that of this reserve air, one-third, i.e., 500 c.c., can be forced out from the chest by pressure, and, as a matter of fact, considerably more than that amount can be expelled when the pressure is applied in the prone position as just described. By repeating the movements—pressure and relaxation—twelve times a minute, we easily get an air exchange of 6000 c.c., which is more than the average normal amount."